**Expression of Interest (EOI)**

**Questionnaire**

*(Use this template for your document. The document can be at most 10 pages long, in this style, font and font size, but you can have appendices and do not have to include the tables in the page count. There is no prescribed format of the document, but you are asked to address the questions below. It is understood that maybe not all questions can be answered precisely, everybody is asked to fill the questions as good as currently possible. All submitted public Questionnaires will be viewable here (https://indico.bnl.gov/event/8552/). You can also submit a separate document with certain information you would only like to be viewable by the EIC Project. DEADLINE FOR SUBMISSION: NOVEMBER 1.)*

**Please indicate the name of the contact person for this submission:**

*(we ask for one main contact person per submission. You can as needed provide further contacts, but there should be one primary contact)*

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**Please indicate all institutions collectively involved in this submission of interest:**

*(even if institutions can submit on their own, it is highly encouraged to form groups to work together within their country, their geographical region, or as a general consortium)*

Central China Normal University (CCNU)

China Institute of Atomic Energy (CIAE)

Fudan University (FDU)

Institute of Modern Physics, Chinese Academy of Sciences (IMP)

Shandong University (SDU)

South China Normal University (SCNU)

Tsinghua University (THU)

University of Science and Technology of China (USTC)

**Please indicate the items of interest for potential equipment cooperation:**

*(indicate experimental equipment components, including those integrated in the interaction regions, each separately)*

In general, we are interested in the gluon contributions to the nucleon structure, especially the spin structure and other related properties. In order to achieve this, we plan to work on the following hardware items：

1. Micro Pattern Gaseous Detectors (MPGD) including GEM/THGEM, uRWELL, Micromegas can be potentially used as candidates of barrel/forward tracker as well as the readout of TPC, RICH detectors with good spatial resolution, high gain and low ion back flow under high rate environment. USTC is now working on a funded R&D project of these detectors and electronics for Super Tau-Charm Facility (STCF) in China, some similar technology and part of the man-power can be shared. (Institutes: USTC, CIAE, IMP）
2. Small-strip Thin Gap Chamber (sTGC) can serve as another option for tracking in the forward region at the EIC, which is high radiation resistant and can provide a position resolution of about 100 microns. sTGC can also serve as a trigger detector with fast response within ~25ns. The readout electronics of sTGC can use VMM chip as designed for LHC experiments. (Institute: SDU)
3. EMCal based on Tungsten-Powder/Scintillating Fiber (W/ScFi) Technology. EMCal based on Lead-Scintillator Plate Shashlik (Pb/Sc) Technology. SiPM and the Readout Electronics. In addition, we are considering working on ZDC (Zero Degree Calorimeter) in the very forward region to measure the neutrons and photons from beam Coulomb excitation. (Institutes: FDU, THU, SDU, CIAE, SCNU)
4. We are part of the silicon consortium for the EIC. Based on the state-of-the-art Monolithic Active Pixel Sensor (MAPS) technology, the silicon tracker will enable precise measurements of short-lived hadrons as they have a much better radiation tolerance, a much better spatial resolution (<15 microns) and a much faster integration time. We have experience in MAPS sensor and readout electronics, including design, assembling and tests. We will work on both barrel and forward disk full silicon tracker at the EIC. (Institutes: CCNU, CIAE, IMP, SCNU)

**Please indicate what the level of potential contributions are for each item of interest:**

*(e.g. indicate if contributions are for full in-kind experimental equipment components – we have provided a rough direct cost estimate for many components in an appendix (see slide 10 & 11 at*

*https://indico.bnl.gov/event/7449/contributions/35863/attachments/27277/41597/EIC.Comp.Det.032020.eca.pptx, if contributions are for partial in-kind experimental equipment components, if contributions are for in-kind labor contributions, etc.).*

1. MPGD: R&D and partial in-kind contributions on mass production of barrel/forward MPGD trackers or the readout of TPC/RICH detectors.
2. sTGC: R&D and partial in-kind contributions on mass production of sTGC chamber.
3. EMCal: Depending on the final choice of the EMCal detector technology, the Chinese EMCal consortium intends to make a significant contribution to the EMCal block construction with most materials and resources from China. Our plan is to contribute to the EMCal detector in the forward direction of the hadron endcap region, including ZDC. But we will also be open to other possibilities if the opportunity for a barrel EMCal detector fits our constraints better when the construction project begins. The Chinese EMCal consortium may also be willing to take more construction responsibility for EMCal blocks if EIC project can provide funds for materials necessary. In this case, the Chinese EMCal consortium will make an additional in-kind contribution to the labor necessary for the construction project.
4. Silicon detector: Participate in R&D, partial in-kind contribution to mass production and characterizations of large-area MAPS sensor and readout electronics.

**Please indicate what, if any, assumptions you made as coming from the EIC Project or the labs for your items of interest:**

*(e.g., indicate if you include engineering and design activities or assume those to come from the EIC Project, if you assume certain material costs to be covered by the EIC Project, if you rely on existing capabilities at the labs, etc. Try to be as inclusive as you can be.).*

1. Overall assumption: The contributions are based on the assumption that we can obtain adequate funding support for US EIC participation from Chinese funding agencies, such as NSFC.
2. MPGD and sTGC: The readout electronics is based on VMM chip developed at BNL, so in general an assumption is that VMM chip will be available through collaboration with EIC project.
3. EMCal: We expect that the final design of the EMCal will be completed jointly with the rest of the EMCal groups from all over the world and under the leadership of the EIC project. The final assembly and installation will be done at BNL. The required mechanical engineering and technical support will be provided by EIC project.
4. Silicon: We are part of the full silicon tracker consortium. We will make our contributions through that collaboration.

**Please indicate the labor contribution for the EIC experimental equipment activities:**

*(e.g., for each cooperation and/or institution list the number of senior staff, the number of postdocs, and the number of graduate and undergraduate students that you plan to dedicate to the EIC experimental equipment activities. Similarly, please list the number of engineers, designers and technicians included in your potential cooperation).*

The time commitment of members of the <INSTITUTION NAME> group in the EIC efforts described in this EoI is anticipated to be as follows:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Institution Name | Professor | Research Professor | Staff Scientist | Postdoc | Graduate Student | Undergrad. student | Engineer | Designer | Technician | Total Sum |
| CCNU | 0.2 |  |  |  | 0.5 |  |  |  | 1.0 |  |
| 0.2 |  |  |  | 0.5 |  |  |  |  |  |
|  | **2.4** |
| CIAE |  |  | 0.4 |  | 0.5 |  |  |  | 0.8 |  |
|  |  | 0.2 |  | 0.5 |  |  |  |  |  |
|  |  | 0.2 |  | 0.5 |  |  |  |  |  |
|  |  |  |  | 0.3 |  |  |  |  |  |
|  |  |  |  | 0.3 |  |  |  |  |  |
|  | **3.7** |
| FDU | 0.2 |  |  | 0.25 | 0.25 |  |  |  |  |  |
| 0.2 |  |  | 0.25 | 0.25 |  |  |  |  |  |
|  |  |  |  | 0.25 |  |  |  |  |  |
|  |  |  |  | 0.25 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  | **1.9** |
| IMP |  |  | 0.4 | 0.5 | 0.5 |  | 0.5 |  |  |  |
|  |  | 0.3 | 0.5 | 0.5 |  |  |  |  |  |
|  |  | 0.3 |  | 0.5 |  |  |  |  |  |
|  |  |  |  | 0.5 |  |  |  |  |  |
|  | **4.5** |
| SDU | 0.2 |  |  |  | 0.5 |  | 0.5 |  | 1.0 |  |
| 0.2 |  |  |  | 0.5 |  |  |  | 1.0 |  |
| 0.2 |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | **4.1** |
| SCNU | 0.2 |  |  |  | 0.5 | 0.2 |  |  |  |  |
| 0.2 |  |  |  | 0.5 | 0.2 |  |  |  |  |
| 0.2 |  |  |  | 0.5 |  |  |  |  |  |
|  | **2.5** |
| THU | 0.2 |  | 0.2 |  | 0.5 |  |  |  |  |  |
|  | **0.9** |
| USTC | 0.2 |  |  | 0.5 | 0.5 |  |  |  | 0.2 |  |
| 0.2 |  |  |  | 0.5 |  |  |  |  |  |
| 0.2 |  |  |  |  |  |  |  |  |  |
|  | 0.2 |  |  |  |  |  |  |  |  |
|  | 0.2 |  |  |  |  |  |  |  |  |
|  | **2.7** |
| **In total:** | **22.7** |

NOTE: FTE in the above table represents the annual fractional full time equivalent (FTE).

NOTE: for a professor, full-time equivalent research time may be limited to 25% max, for a research professor (or a sabbatical) or a staff scientist limited to 50% max, for a postdoc maybe 100%, and for a grad. student perhaps 50% (on average). For an undergraduate student research time (on average) is limited to 20% max.

*(Repeat this table for each institution, or include the information for the whole group/consortium together in one table as shown above.* ***This reflects an annual average FTE estimate.*** *Please state below for how many years you estimate this average cooperation level to be valid.)*

It is anticipated that the collaborative effort of <INSTITUTION A> to cooperate on the EIC Project is to include (at an annual basis) 0.2 full-time equivalent FTEs of a professor, 0.3 FTE of a research professor, 1.0 FTE of a postdoctoral researcher, and 0.9 FTEs of Ph.D. students. The technical collaborative effort contributed is to include up to 0.8 FTE of a (mechanical or electronics) engineer, 0.5 FTE of a designer, and 1.0 FTE of a technician. We anticipate the duration of this collaborative effort to cooperate on the EIC Project to start at the <DESIGN/CONSTRUCTION> phase and to be for a period of <TWO/THREE/FOUR/FIVE> years.

**Please indicate if there are timing constraints to your submission:**

*(e.g., indicate any known or anticipated timing profile assumed in your EOI. This can include anticipated time frames folding in constraints due to ongoing commitments, due to ongoing R&D and its anticipated completion date, etc.)*

FTE starting time is 2021 and it lasts as long as EIC project is going on.

**Please indicate any other information you feel will be helpful:**

*(e.g., this could be things like assembly and storage space at your institute, clean rooms and class, special skills or machine shops, or perhaps some pointers to past accomplishments – you can expand on those in an appendix. If you could make existing engineering, design or technician labor available to the EIC experimental equipment but would rely on funds coming from the EIC Project you can also list those here).*

1. Concerns:

Uncertainties include effects from the global pandemic of COVID-19, and from the political relationship between US and China. These effects may result in difficulties in traveling between US/China, and grant application related to US/China collaboration. Those difficulties will reduce the effectiveness of communications among scientists.

1. Silicon detector:

Resource from China: Clean rooms of ISO6 and ISO7 (in total of 200 m2), well trained technicians and faculties with experiences on the ALICE ITS2 HIC module assembly & test and other experiments.

We have a few institutes in China working on pixel chip R&D and silicon detector development.

1. EMCal:

Professional mass production line has been established for future experiments. The Chinese EMCal consortium has adequate man-power to carry out the R&D, design and prototype testing of the detector technologies that we have expressed interest. Without going into the details for each Chinese Institution, we expect that the Chinese EMCal consortium will have enough staff, post-doc, graduate and undergraduate students to carry out the EMCal block production in China.